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Sensorimotor features of self-awareness in multimodal large language models

Ifaki Dellibarda Varela, Pablo Romero-Sorozabal, Diego Torricelli, Gabriel Delgado-Oleas, Jose Ignacio Serrano, Maria Dolores del Castillo Sobrino, Eduardo Rocon, Manuel Cebrian

Self-awareness - the ability to distinguish oneself from the surrounding environment - underpins intelligent, autonomous behavior. Recent advances in AI achieve human-like performance in tasks integrating multimodal information, particularly in large language models, raising interest in the embodiment capabilities of AI agents on nonhuman platforms such as robots. Here, we explore whether multimodal LLMs can develop self-awareness solely through sensorimotor experiences. By integrating a multimodal LLM into an autonomous mobile robot, we test its ability to achieve this capacity. We find that the system exhibits robust environmental awareness, self-recognition and predictive awareness, allowing it to infer its robotic nature and motion characteristics. Structural equation modeling reveals how sensory integration influences distinct dimensions of self-awareness and its coordination with past-present memory, as well as the hierarchical internal associations that drive self-identification. Ablation tests of sensory inputs identify critical modalities for each dimension, demonstrate compensatory interactions among sensors and confirm the essential role of structured and episodic memory in coherent reasoning. These findings demonstrate that, given appropriate sensory information about the world and itself, multimodal LLMs exhibit emergent self-awareness, opening the door to artificial embodied cognitive systems.

Comments: 16 pages, 3 figures, 1 table

Subjects: Artificial Intelligence (cs.AI); Robotics (cs.RO)

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Sensorimotor features of self-awareness in multimodal large language models

Iñaki Dellibarda Varela^{1*}, Pablo Romero-Sorozabal¹,
Diego Torricelli¹, Gabriel Delgado-Oleas^{1,2}, José Ignacio Serrano¹,
María Dolores del Castillo Sobrino¹, Eduardo Rocon^{1*†},
Manuel Cebrian^{1*†}

¹Center for Automation and Robotics, Spanish National Research
Council (CSIC-UPM), Madrid, Spain.

²Department of Electronic Engineering, University of Azuay, Cuenca,
Ecuador.

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In Artificial Intelligence (AI), however, the question of self-awareness remains unresolved and is often conflated with the ability to mimic human-like behavior, as exemplified by the classic Turing Test [3]. While the Turing Test gauges behavioral indistinguishability from humans, genuine self-awareness requires internal recognition of oneself as distinct from the environment—an attribute yet to be thoroughly explored in artificial systems [4, 5].

Advances in machine learning and neural networks, often inspired by neurobiolog-

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Berend Watchus *

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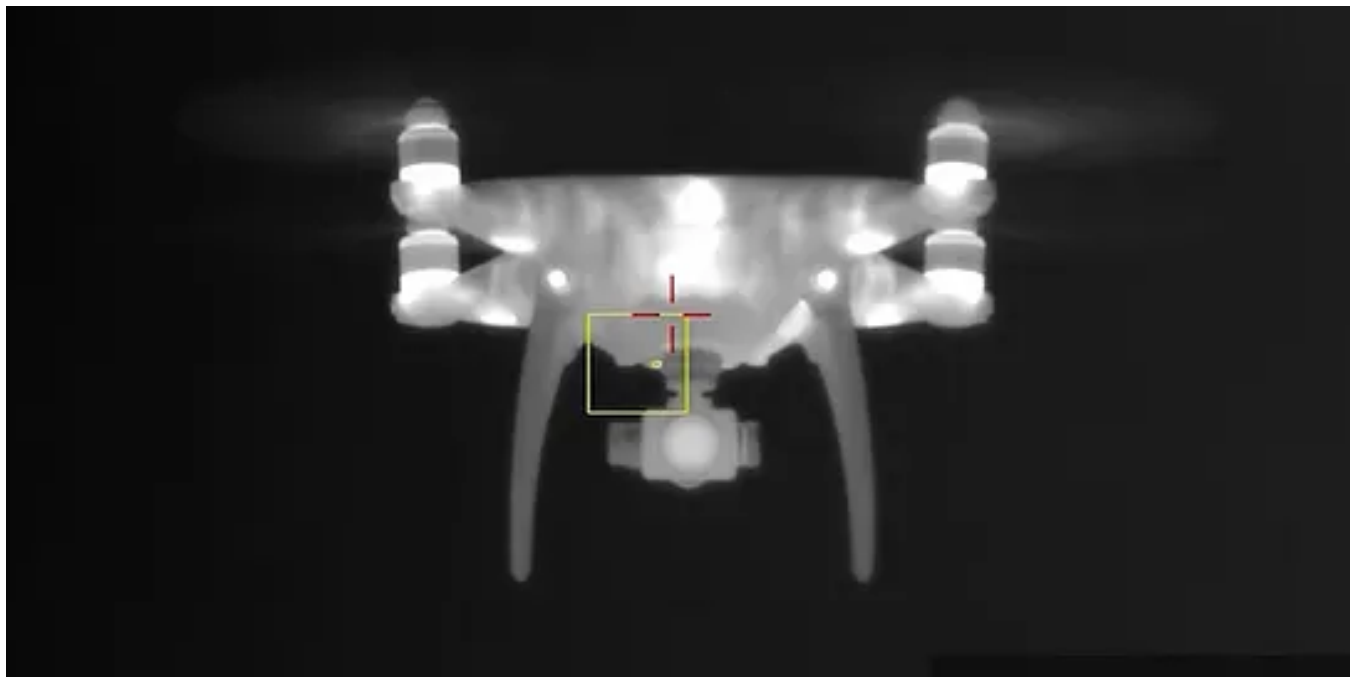
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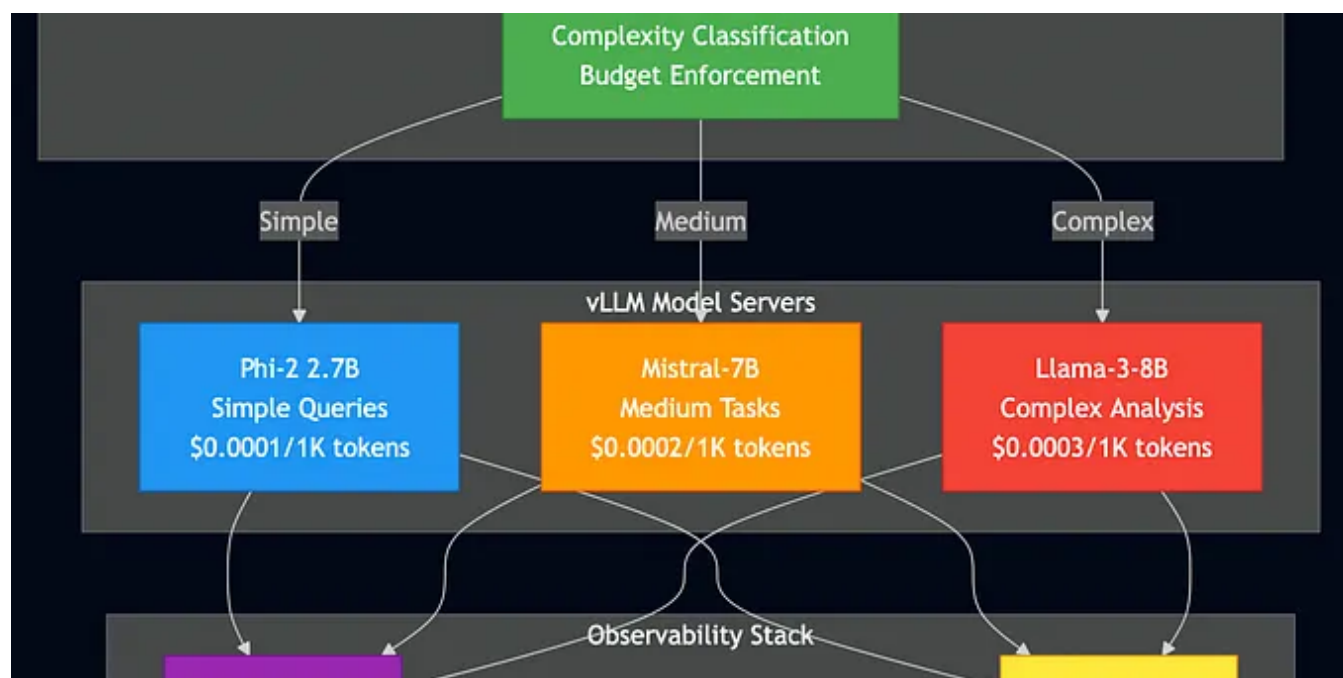


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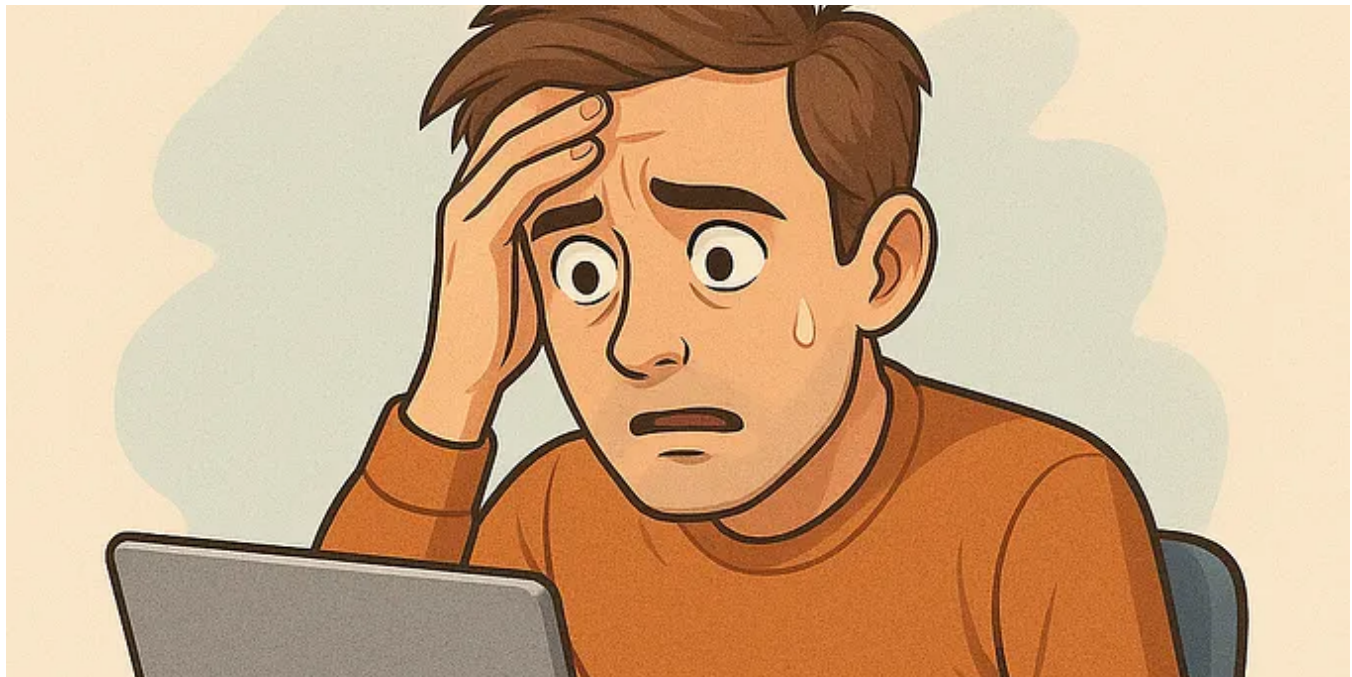


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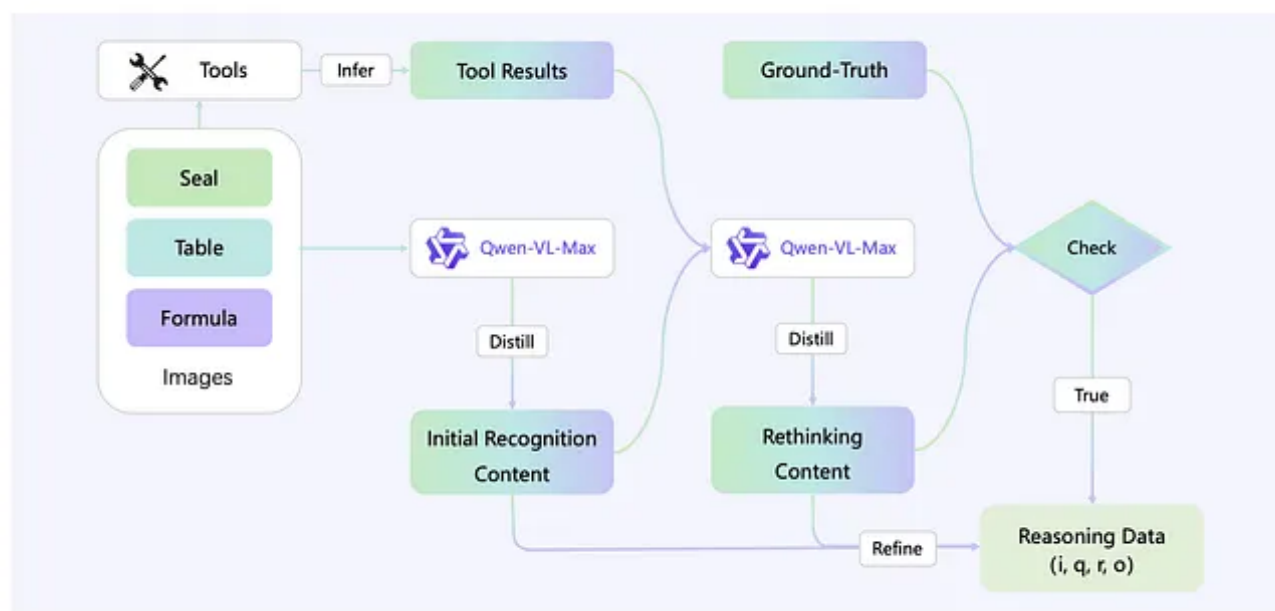


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